



## *Force Projection Technology*

## *Presentation to the NRCC*

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*4 Feb 2014*



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# Force Projection Technology (FPT) Mission



- Serve as the DoD responsible agent for all ground fuels and lubricants specifications: AR 70-12 – Fuels and Lubricants Standardization Policy for Equipment Design, Operation, and Logistic Support
- DOD Lead Lab for Ground Water Supply and Wastewater Treatment per DOD 4705.01 and AR 700-136
- National Depository Authority for the US Army on Military Load Classification: STANAG 2021 Military Load Classification for bridges, ferries, rafts, and vehicles
- Execute total life cycle engineering for:
  - Fuel Handling & Quality Surveillance Equipment
  - Water Purification, Handling, & Quality Equipment
  - Combat Engineer & Material Handling Equipment
  - Military Bridging
  - Fuels and Lubricants
  - Army Petroleum Laboratory
- Respond to Maneuver Support Center of Excellence (MSCoE) (EN) and Sustainment Center of Excellence (SCoE) (TC,QM) needs

Multiple  
ONS  
and  
JUONS

Co-located w/  
LCMC partners

Per Army Regulation, TARDEC has Responsibility to Perform the S&T Mission





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# Strategic Guidance



- **Army Strategic Planning Guidance 2013 – Objectives**

- **Reduce Operational Energy and Water Requirements, Develop Operationally Viable Alternative Energy Sources and Increase Water Reuse (FY15-20).** Energy and water are the largest share of logistical requirements. Without adequate energy and water, the industrial base will fail. Improving how forces think about and use energy and water, especially reducing demand for liquid fuel and reusing as much water as possible, will allow the Army to improve intra-theater mobility and distribution, reduce life-cycle sustainment costs, and decrease the amount of combat power that must be dedicated to transporting those resources. In concert with reducing energy requirements, the Army's development of alternative energy sources and increases in water reuse will lead to a great number of operational options.



## **Army Top Challenges:**

4. Reduce logistic burden of **storing, transporting, distributing and retrograde** of materials
8. Improve **operational energy**

## **Operational Vulnerability:**

- 70-80% of resupply weight in theater consists of fuel and water. With 18% of US casualties in OIF and OEF related to ground resupply.
- Threat to Installation Energy Supplies.

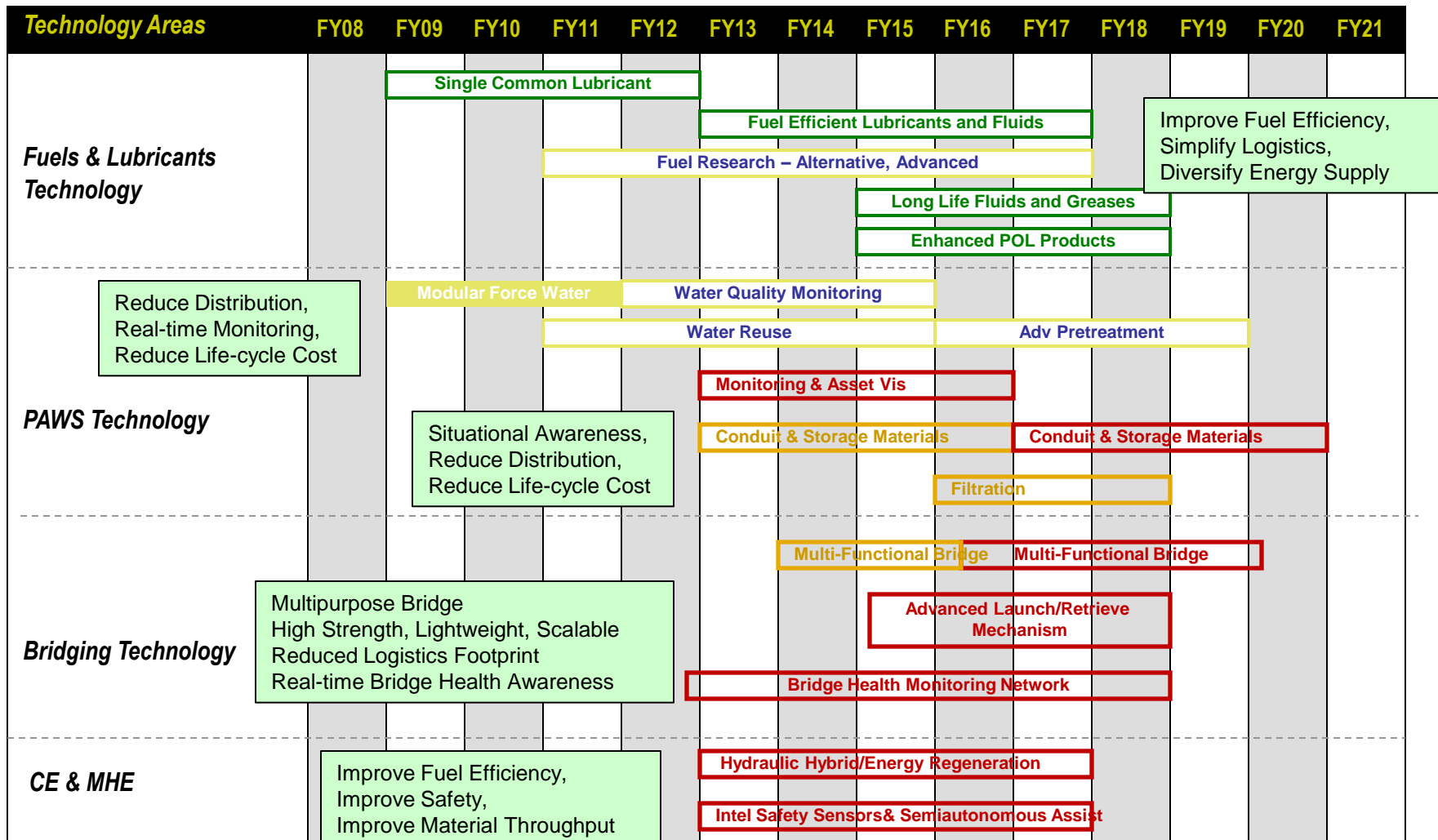
“Operational Energy equates exactly to operational capability”  
-General John Allen, Commander United States Forces - Afghanistan

“Improving our energy security directly translates to improving our national security. It will be essential to keeping our military the most effective, the finest fighting force in the world. And, it is inherent to our responsibilities as good stewards of the nation's resources.”  
- General Martin Dempsey, Chairman of the Joint Chiefs of Staff



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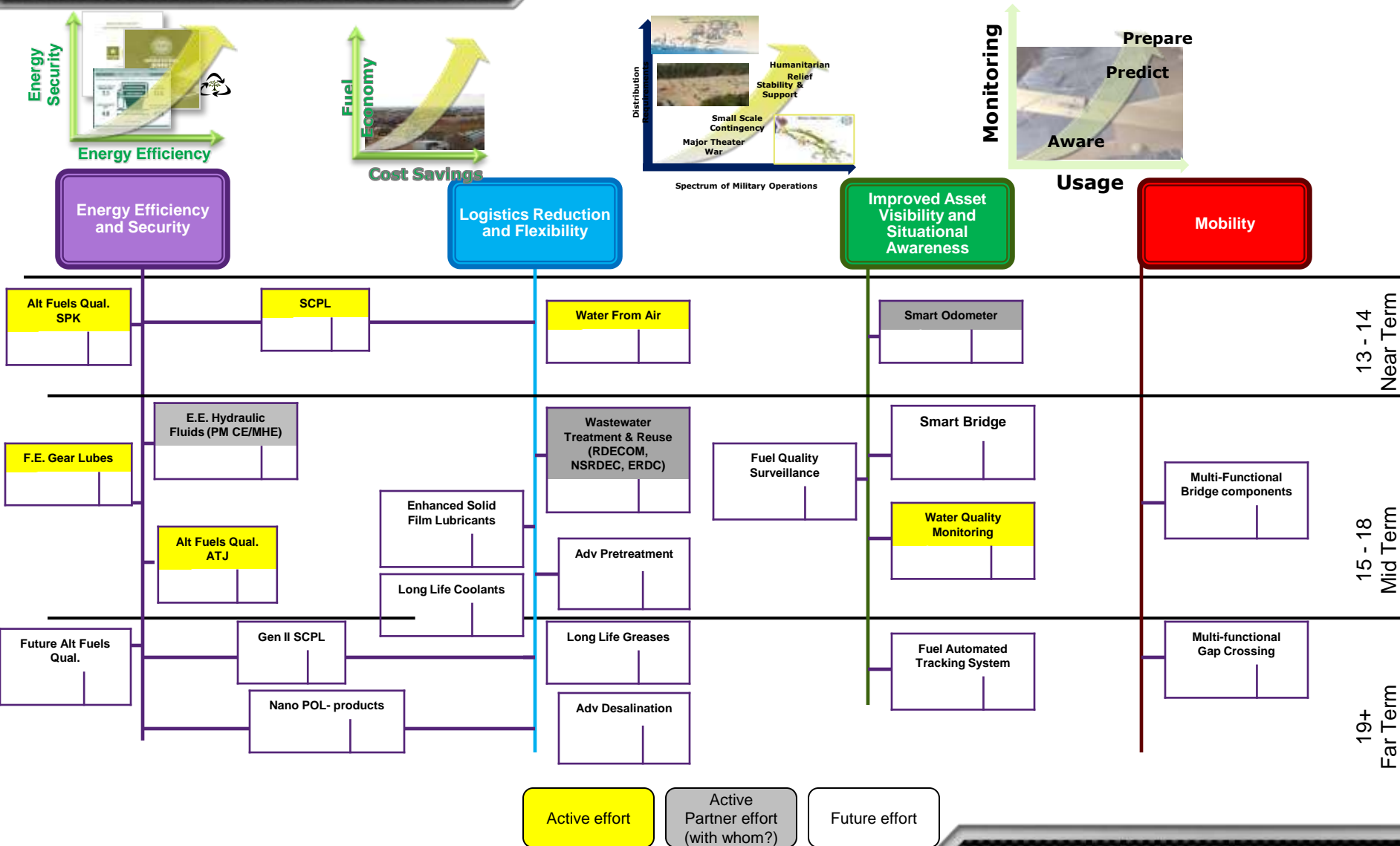
# Force Projection Technology Roadmap





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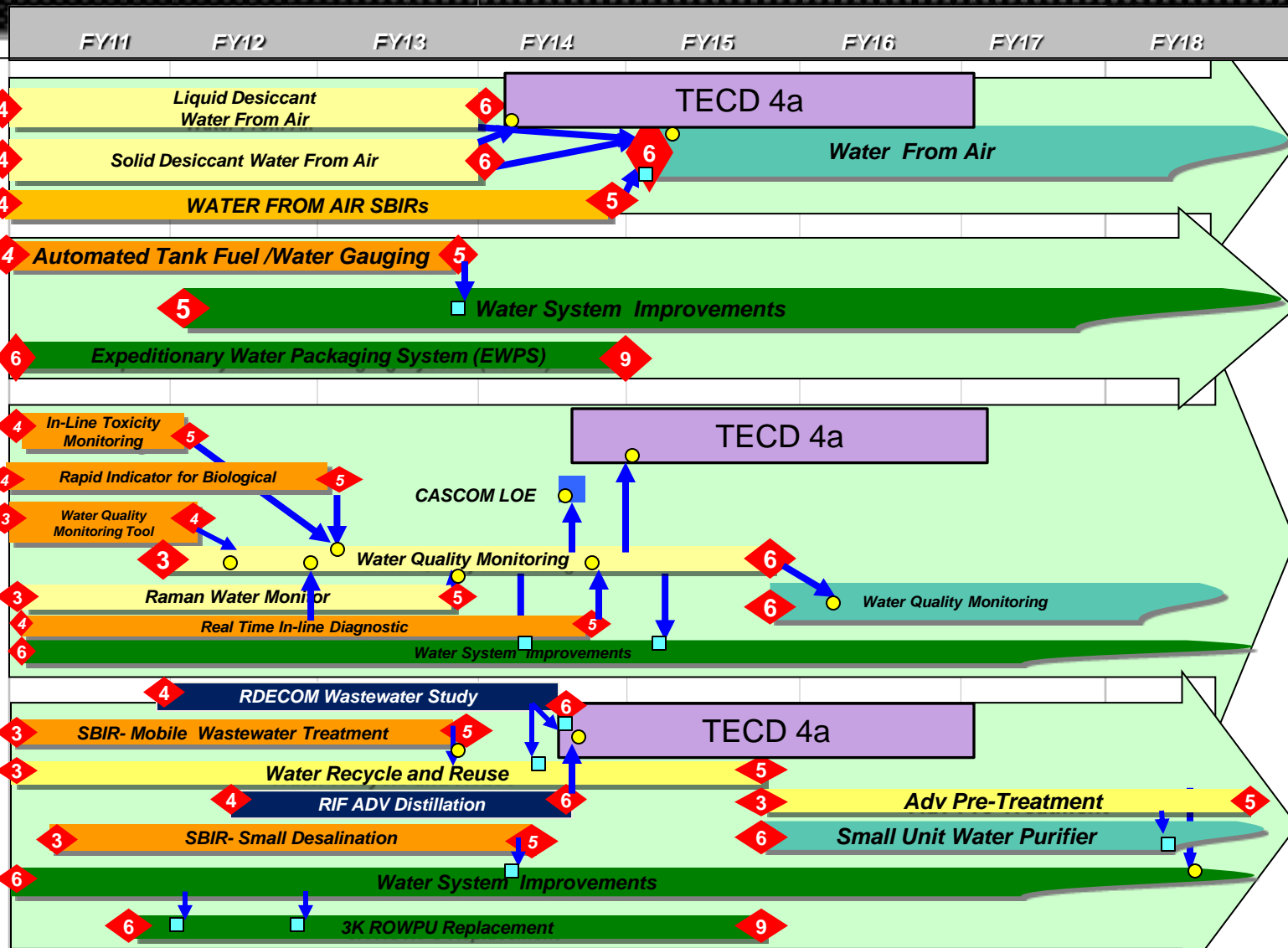
# Technology Research Framework





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# Force Projection Technology Water Systems Technology Roadmap



## WATER GENERATION

Production of Potable Water from Atmospheric Humidity

## WATER STORAGE AND DISTRIBUTION

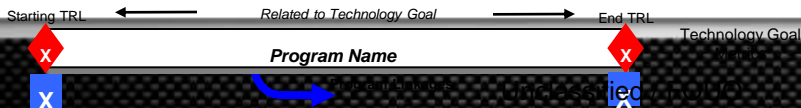
## WATER MONITORING

## WATER TREATMENT

### Key:

- Knowledge
- ★ Technology
- Capability

### LEGEND



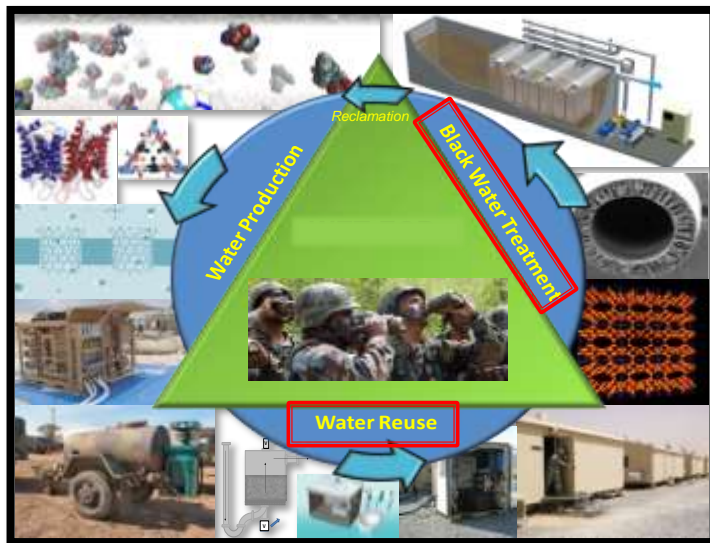
- CRADA Program
- SBIR Program
- External Funding
- TARDEC Core Program
- PM PAWS Funded Program
- Future Planned Programs





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# Blackwater Treatment & Gray Water Reuse



**Schedule & Cost**

MILESTONES	FY12	FY13	FY14	FY15	FY16
Develop Technologies					
Demonstrator Systems					
Performance Testing					
Modify & Field Evaluation					
TeCD 4a Demonstration					

Milestone Indicators:

TRL or SRL:



Milestone Timeline:



## Purpose:

- Develop and integrate multiple technologies to produce compact, mobile, energy-efficient systems capable of rapid start-up that can eliminate blackwater (not currently being addressed with an Army system) and treat gray water (being addressed in a limited capacity) to non-potable reuse standards
- Develop a prototype and demonstrate system effectiveness for meeting challenges: Lower energy usage (<20 W-H/Gal to Net Zero W-H/Gal), Increased recovery (80% of influent), Varying load conditions (treating wider spectrum of feed waters), Quicker start-up (1-2 days), Non-MOS operation

## Products:

- A stand-alone blackwater treatment system (TRL 6) that treats to discharge standards water from current CSS equipment to include Field Feeding and Medical Systems & Latrines
- A gray water reuse technology (TRL 6) that treats water from current CSS equipment to include Water Purification Systems & Shower and Laundry Systems
- DOTLMPF analysis at TeCD 4a, will inform requirements document

## Payoff:

- Reduces convoys and dollars required to provide potable water (for non-potable uses) potentially providing an order of magnitude cost savings for Army water logistics support
- Reducing water convoys saves more soldiers' lives
- Ties directly to OE & Base Camp ICD and Force Provider CPD
- Contributes to maintaining TARDEC's core competency in water and wastewater treatment
- Supports the expeditionary base camp initiative





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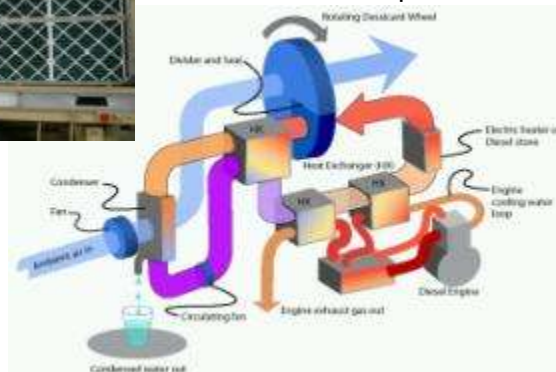
Water from Air

# Water from Air



Solid desiccant prototype system

Solid desiccant process



Schedule & Cost

MILESTONES	FY09	FY10	FY11	FY12	FY13	FY14
Design & Fabricate trailer mounted water production demonstrator	4					
Conduct Performance Testing			5			
Conduct realistic testing at AEWE with soldiers			6			
Modification & Optimization of solid desiccant system						
Participate in TeCD 4a planning & demonstration						
TOTAL						

Milestone Indicators: TRL or SRL: Milestone Timeline:

## Purpose:

- Provide the next generation of water production and distribution capabilities through mobile water-from-air generation/storage.
- The effort does this by generating water from atmospheric humidity using absorption/desorption desiccant technology, energy recovery and condensation.
- Assess prototype system at Aberdeen Test Center (ATEC) and Technology-enabled Capabilities Demonstration (TeCD 4a)

## Products:

- A stand-alone 7.5-ton trailer mounted, solid desiccant based, 500 gallon per day water production system (TRL 6) to provide potable water at the point of use
- Technical and design data required to develop a purchase description
- Analysis of DOTLMPF requirements through TeCD 4a Sustainability and Logistics - Basing

## Payoffs:

- Fills Water from Air capability gap identified in Petroleum & Water Functional Solutions Analysis
- Reduces the logistical footprint associated with bulk liquid storage and distribution by 50 to 75%
- Economic analysis using the Sustain the Mission Project methodology demonstrates payback in less than 1 year
- Reduces or eliminates base camp water resupply
- Transitions to PM PAWS in FY15



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# Water Quality Monitoring



Current Monitoring



Future Monitoring



## Purpose:

- Provide enhanced real-time monitoring capability for Site Reconnaissance, Water Purification Equipment Operation, and Water Certification

Identifying key detection technologies that can be developed on a micro-scale platform and capable of transitioning to a field hardened material solution.

## Products:

- Hand-held biological and chemical contaminant detector.
- Inline real time monitoring of water quality parameters
- Monitor and report water quality, quantity & location

## Payoffs:

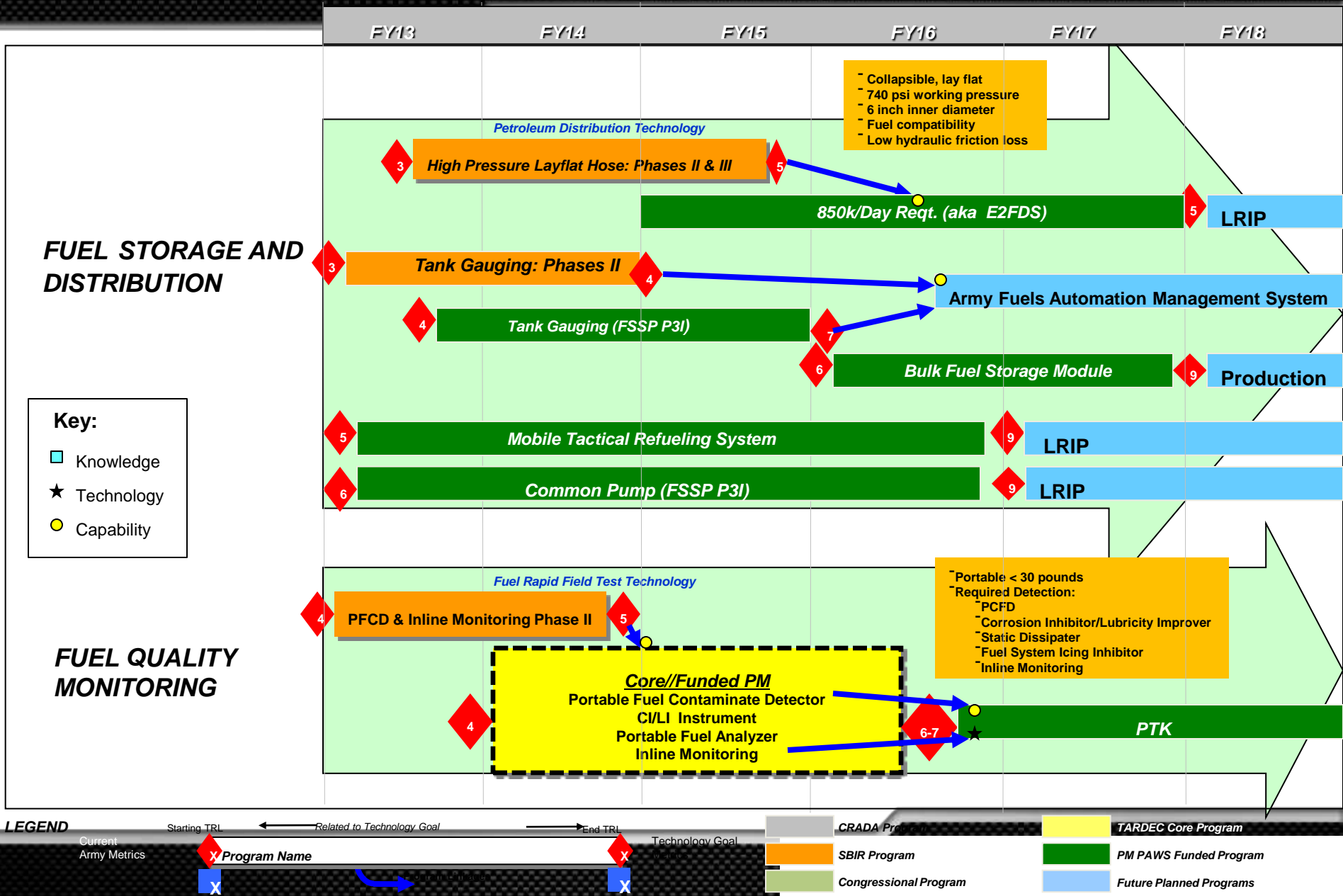
- Address current deficiencies in the capability of the WQAS-P and WQAS-PM to monitor contaminants identified in TB MED 577 & Tech Guide 230
- **Enable the fresh water by-pass to double water purification system production on suitable sources.**
- Reduce microbiological water quality testing from 24 hours to less than 1 hour
- Provide real time monitoring of GAC during NBC operations.

PRODUCTS	FY13	FY14	FY15
Test In-line automated monitor	5+		6+
Develop Disease and Toxin Surveillance	4+	5	6
Inform Future Requirements			
Transition Reviews with PM PAWS			



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# Force Projection Technology Petroleum Storage & Distribution Roadmap

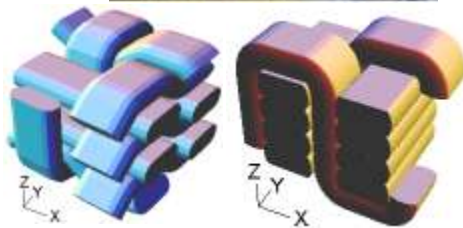






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# Early Entry Fluid Distribution System



## Purpose:

- **Build upon Phase II “low risk” results to engineer, fabricate and qualify field ready prototypes**
- **To develop and evaluate a comprehensive matrix of candidate composite material systems and textile reinforcement architectures via modeling/analyses and testing.**

## Product(s):

- **Validated Dynamic Modeling tool based on parametric study using material models to reliably predict the textile mechanics of the hose response under all expected loading conditions.**
- **Analysis Study recommending hose formulations and physical architectures that meet cost and operational criteria.**
- **Test Report documenting performance of production representative hose samples**

## Payoff:

- **10X Increase in Deployment/Retrieval rate**
- **Doubling Pressure cuts number of pump stations in half - reduced Logistics Footprint, Manpower, Energy Costs; sustainment costs and increases reliability,**
- **Transfer technology to PM PAWS under signed TTA**
- **TARDEC develop new analytical and engineering knowledge in composite fibers and fiber reinforced materials**
- **TARDEC multi-disciplinary Survivability, Force Projection, Analytics**
- **Addresses Capability GAPS identified in CNA 15-19;**
- **Addresses Army Challenge Statement “Operational Energy” and “Reduce Logistics Burden”**

## Schedule & Cost

MILESTONES	FY13	FY14	FY15	FY16	FY17	FY18
Complete Phase II SBIR	█					
Screen Potential Fibers		4 █				
Validate Micro-mechanics and FEA models			█			
Conduct Design of Experiments				█		
Fabricate Recommended Hose Samples					█	
Conduct Experiments				5 █		
Modify Dynamic Models					█	
Conduct Cost Analysis						█
Fabricate Test Hose						6 █
Performance Testing						
E2FDS MS B			◆			
E2FDS MS C						◆

**A high pressure collapsible hose is the critical enabling technology for an Early Entry Bulk Fuel Distribution Capability**

TARGET Gates



TRL 1



Significant Activities:





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# Early Entry Fluid Distribution System



## **Purpose:**

- Design, Refurbish and Demonstrate existing hardware and software from Terminated RIFTS program in order to assess technical and operational requirements for BFDS POR

## **Product(s):**

- Refurbished Automated Pump Station and Command and Control System
- Test report documenting performance of commercially available hose IAW Performance Specification
- Trade Study/System Analysis using Simulation Software tools
- Technical Report documenting the performance under various environmental /operational conditions
- Limited Operational Experiment Report

## **Payoff:**

- Requirement Analysis in support of BFDS CDD
- Prototype system available to fill PACOM gap (KTO ROC Drill OCT 2012)
- Provides solutions to GAP identified in the Sustainment CBA and substantiated in the P&W ICD
- Informs CASCOM requirements process (LOE scheduled for 3QFY14)
- Engineering, Design, and Prototyping can be performed in-house utilizing TARDEC SEI resources (Collaboration between FPT, CSI, Advanced Concepts, Analysis, and RAM)
- Low Cost Approach takes advantage of sunk costs (HW reuse)
- Bridges funding gap between now and POR start in FY15 and provides TARDEC engineers opportunity to develop critical skills



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# Fuel Quality Surveillance



## Purpose:

- Develop algorithms and mature technologies that will provide a fuels quality surveillance in minutes.
- Technologies to be investigated include: Light obscuration, light scattering, and ultrasound for contaminate detection; Infrared and visible spectrometry for CI/LI detection, and Near Infrared or Raman Spectrometry for the portable fuel analyzer.















## Product(s):

- Algorithms to be utilized by developed technologies based on TARDEC's library of fuels for each fuel sensor technology selected.
- Fuel use limits for new fuel contamination detection methods.
- Prototype sensor technologies for CI/LI additive quantification (TRL-6), a portable fuel analyzer (TRL-6) and contaminate detection (TRL-7).

## Payoff:

- Instrumentation will be incorporated into the Army Petroleum Test Kit which is a "Laboratory in a suitcase" usable by a MOS 92F soldier providing results in minutes rather than hours or days.
- Gives a fast moving Army the ability to test captured fuel in minutes.
- Increases the number of fuels characteristics that can be checked at the point of issue.
- In line and real time fuels monitoring for several PM-PAWS systems.
- Builds on areas of expertise and innovation in fuel quality and handling cultivated at TARDEC, adding to reputation for technical excellence that TARDEC has built in this competency area. 67% of the TARDEC core funding stays with TARDEC.
- Project will consist of R&D which will spiral instruments to PM PAWS including in line particle counters for fuel contamination detection in the short term with the remainder of instruments to be incorporated into the Petroleum Test Kit.
- Supports PEO-CS&CSS LIRA for development of fuel quality monitoring capabilities to transition to the Petroleum Test Kit.
- Supports PTK Operational Requirements Document and draft Capabilities Production Document.

## Schedule & Cost

MILESTONES	FY14	FY15	FY16
Particle Counter Evaluation		 	
Contaminate sensor Development			
Inline Contaminate Testing		 	
CI/LI Breadboard Evaluation	 		
CI/LI Prototype Development		 	
CI/LI Prototype Testing			 
Portable Fuel Analyzer Prototype			

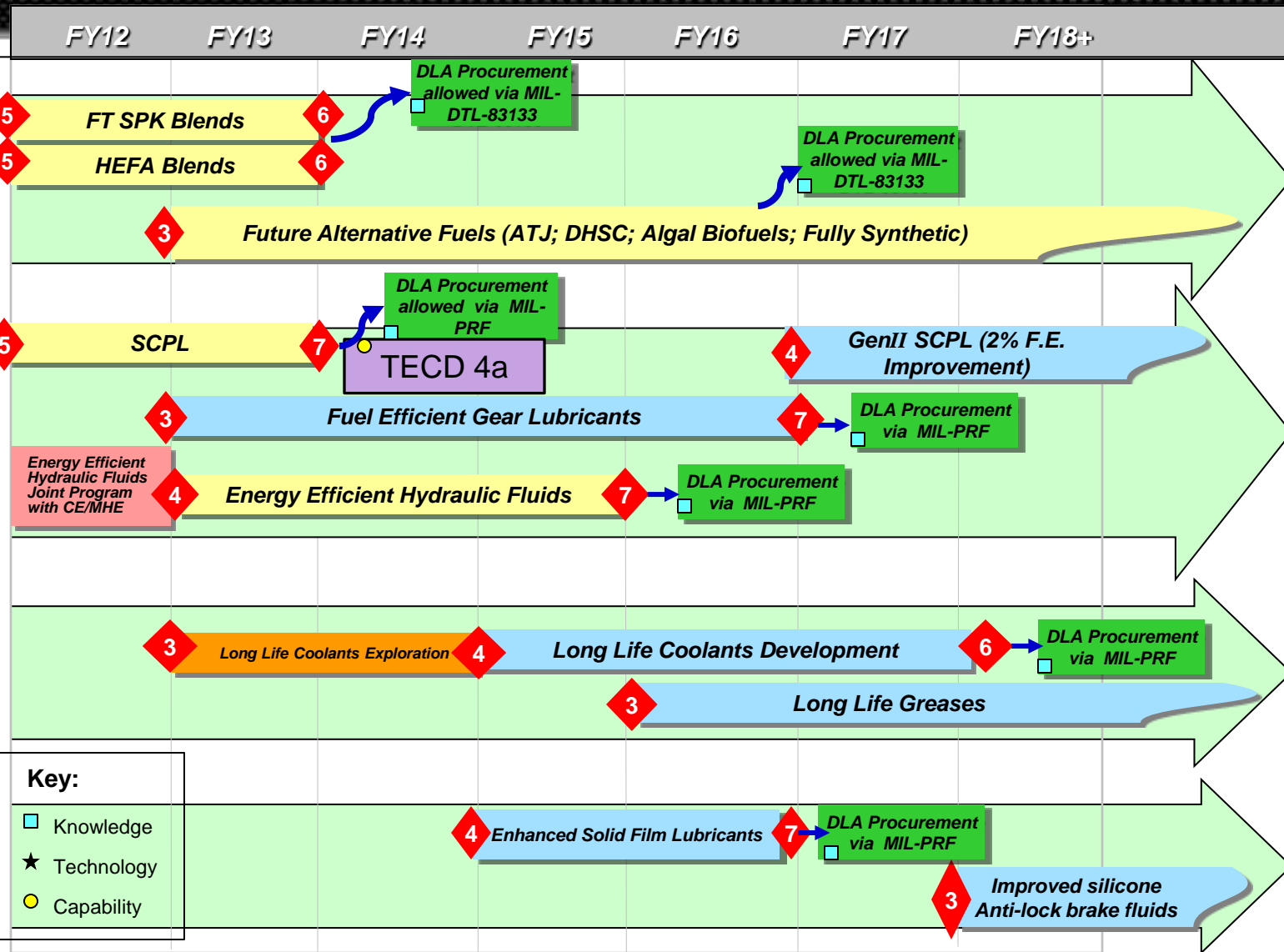
Milestone Indicators:  TRL or SRL:  Significant Activities: 





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# Force Projection Technology Fuels & Lubricants Technology Roadmap



**Key:**

- Knowledge
- ★ Technology
- Capability

**LEGEND**

Starting TRL → Related to Technology Goal → End TRL

Current Technology Goal

Program Name

Program Milestones

Classified / FOUO

PM Funded Program

DLA Funded Program

Congressional Program

TARDEC Core Program

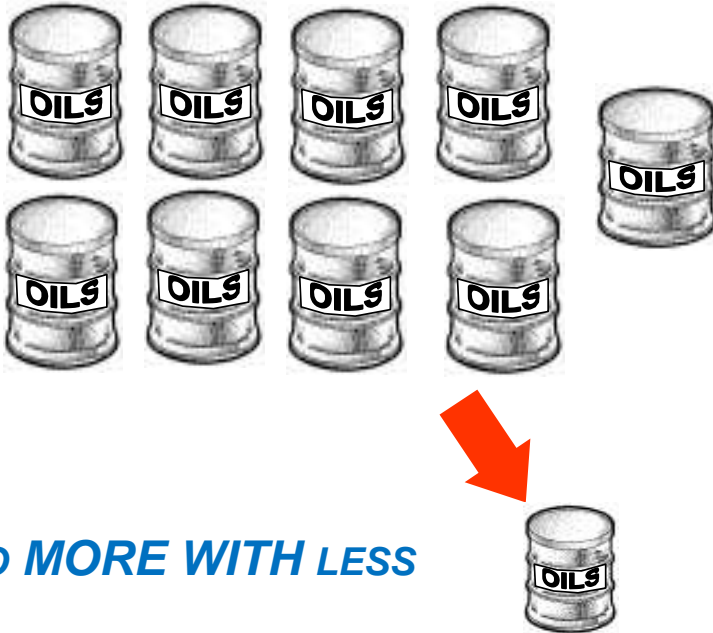
DLA Procurement

Future Planned Programs



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# Single Common Powertrain Lubricant (SCPL)



**Do MORE WITH LESS**



## Purpose:

Provide superior powertrain lubricant that will reduce logistic burden, maintenance requirements, and reduce fuel consumption.

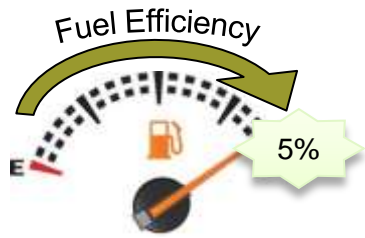
## Results/Products:

A full synthetic, all temperature, combined engine and transmission lubricant, with extended oil drain capabilities, superior high temperature stability, and improved fuel economy.

## Payoff:

- Reduced fuel consumption by 2%
- Increased oil life by at least 2X
- Reduce the number of required standard lubricants from 4 to 1
- Improved low temperature performance
- Enables future low friction engine designs

# Fuel Efficient Lubricants/Fluids



Total \$ 5M

## Schedule & Cost

MILESTONES	FY12	FY13	FY14	FY15	FY16	FY17	FY18
Identify IPT Members							
Define requirements and objectives/metrics							
Candidate Request and P&C testing							
Contract with TFLRF							
Fuel Efficiency Test Development							
Candidate Eval./Reformulation I		3	4				
Candidate Eval./Reformulation II					6		
Contract with MSOE							
Fuel Efficiency Test Development							
Candidate Eval./Reformulation I		3	4				
Candidate Eval./Reformulation II					6		
Final Reports							
Field Demonstration						7	
Specification modified/developed							

## Purpose:

Contribute to Army's energy efficiency goals by developing **fuel efficient gear lubricant and hydraulic fluids**; in addition, reduce logistic burden and costs as these will have **increased oil/fluid change intervals– 2X over baseline**

## Results/Products:

- Lubricants/fluids with a **5% combined fuel efficiency** improvement
- Full synthetic products to meet the oil drain interval goals of **2X over baseline**
- Robust lubricants and fluids with no modifications to equipment hardware

## Payoff:

- Combined fuel consumption reduction of 5%
- Increased oil life – less frequent oil changes, less maintenance, less waste
- Supports WFO No. 14 and No. 46
- Product transition will be transparent to the user
- Supports DoD and Army KPPs for Energy Efficiency
- Reduces fuel consumption requiring less deliveries/convoys which reduces soldiers exposure to harm





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# Alternative Fuels Qualification: ATJ



## Schedule & Cost

MILESTONES	FY13	FY14	FY15	FY16
Fuel Receipt, Blend/Additize	3	Lot 1	Lot 2	
Fuel Blending Study		4		
Fuel Injecton System Eval		5		
Grd Vehicle Engine Eval				6
Gen Set Eval			6	
		*		

### Purpose:

- Evaluate the properties of Alcohol-to-Jet (ATJ) blending stock and ATJ fuel blends to understand their properties and how they differ from petroleum JP-8. Evaluate the impacts on performance of equipment that operates on them to understand differences in performance from that of equipment that operates on petroleum JP-8.

### Product(s):

- Fuel evaluation reports (TRL 4)
- Fuel injection system evaluation reports (TRL 5)
- Ground vehicle engine and gen set evaluation reports (TRL 6)
- Revised JP-8 spec with requirements for ATJ blending stock and ATJ blends (FY16)

### Payoff:

- The Army will be prepared to use ATJ blends, as approved and implemented through revision of the JP-8 specification.
- Supports DoD Operational Energy Strategy and associated Implementation Plan issued May 2011 and March 2012, respectively.
- Supports Army Campaign Plan Major Objective 8-2 to Enhance Operational Energy Effectiveness.
- Increased knowledge of alternative fuel properties and their impacts on the performance of military ground systems.
- Further builds TARDEC's reputation as the DoD center of expertise for ground fuels, thus contributing to Cultural Identity "Preferred Source for Ground Vehicle Life Cycle Engineering"
- Supports commonality through fuel standardization, i.e., single kerosene-based fuel is the primary fuel support for land-based air and ground forces, and sea-based aircraft.
- Aligned with the FPT Business Area Strategy for FLTT Core Programs providing POL product life-cycle engineering support.
- Product Development as it will qualify and approve ATJ blends and transition Army fuel property requirements to DLA-Energy through a revision of the JP-8 specification in FY16.

Milestone Indicators: TRL or SRL: Significant Activities:



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# Force Projection Technology Bridging Systems Technology Roadmap



## ADVANCED BRIDGING MATERIALS

Develop lighter, stronger, scalable bridges  
Application of composites

### Key:

- Knowledge
- ★ Technology
- Capability

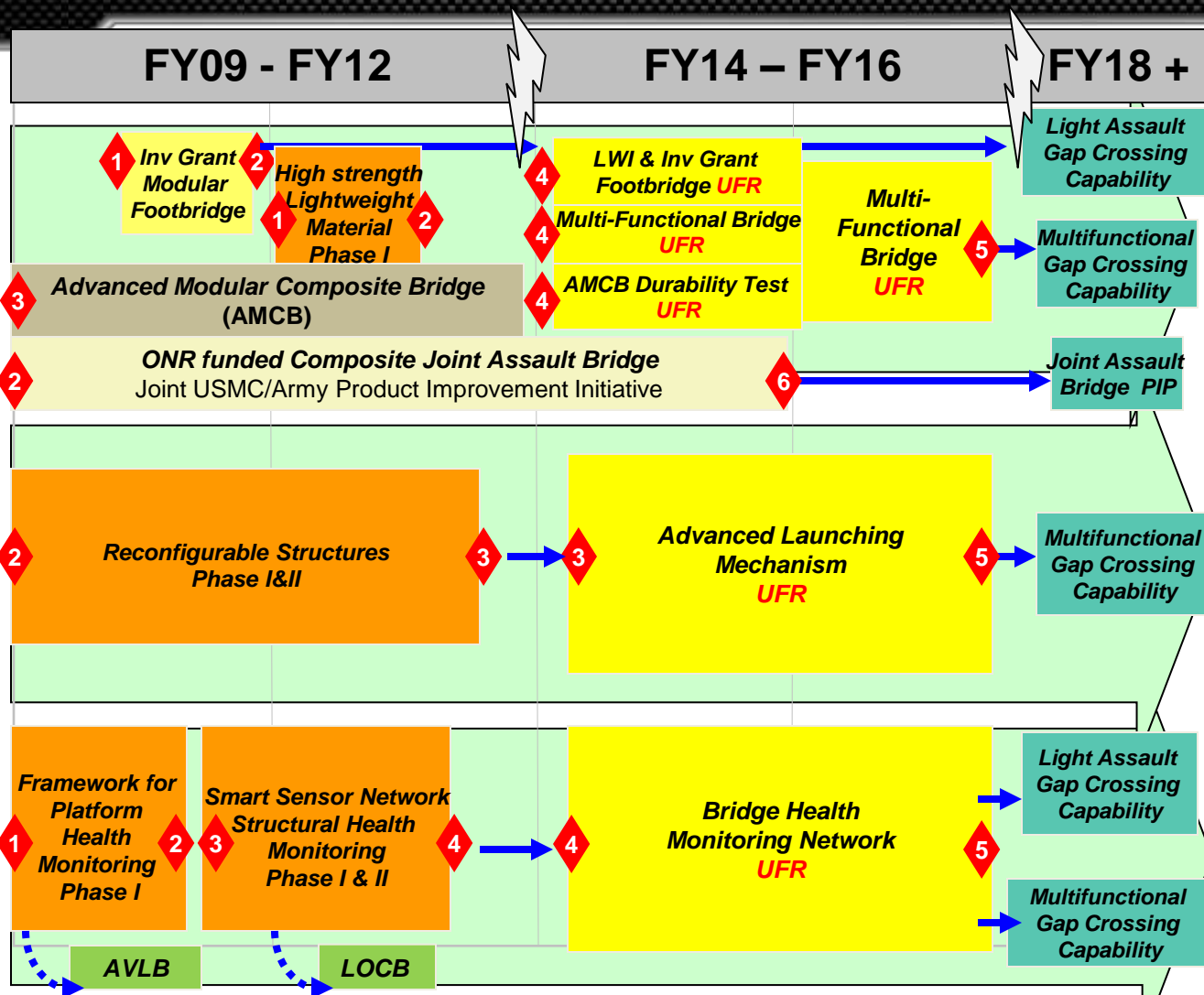
## ADVANCED LAUNCHING MECHANISM

Reconfigurable single solution for Assault,  
Tactical, & Line-of-Communication gap  
defeat

## BRIDGE HEALTH MONITORING

Technology to identify vehicles, count  
crossings, and monitor bridge usage and  
health.

Mechanism to calculate vehicle Military  
Load Classification in real-time to  
communicate with bridge health sensors.



## LEGEND

Starting TRL X → Related to Technology Goal X End TRL

**Program Name**

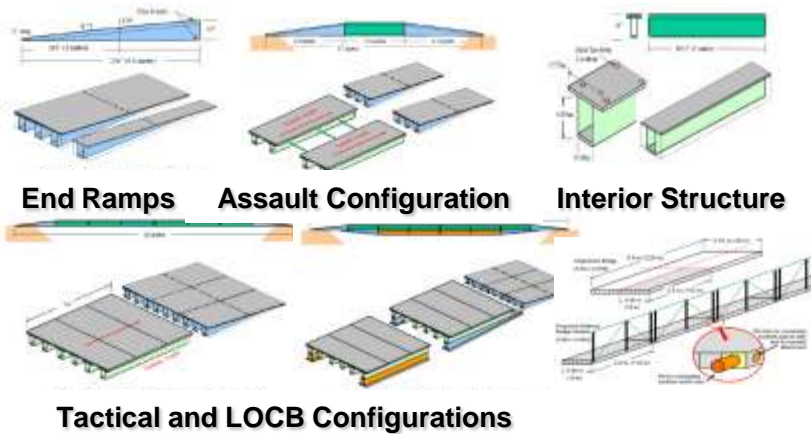
    Joint Program     SBIR Program     Congressional Add

    TARDEC Core Program     PM Funded Program     PM Future Planned Programs



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# Multi-Functional Bridging Technology Phase I – Design Phase



## Purpose:

- Assess use of composites and other advanced materials for bridging applications; create and develop new bridge system design/ architecture to enable use in multiple bridging missions.
- Leveraging work performed in Multi-Functional Bridging Concepts FY13 Innovation Grant, previous SBIR/ DARPA/ Congressional Add efforts, AVPTA composite- metal bolt bearing and by-pass project

## Product(s):

- Evaluation of applicability of composites, advanced materials for bridging applications (Report, PdM Bridging, 4QFY14)
- Critical Design Review of conceptual design (4QFY15)
- High Strength, Lightweight, Scalable Bridge and Advanced Launch/ Retrieve Mechanism Design/ Manufacturing Drawings (TRL 5, PdM Bridging, 4QFY15)

## Payoff:

- Transition of concepts to PEO CS&CSS, PdM Bridging for Multi-Functional Gap Crossing Capability (MFGCC) EMD
  - Draft CDD being worked by Maneuver Support Center of Excellence (MSCoE)
- Collaborative effort with TARDEC Center for System Integration (CSI) on design development, TARDEC Ground System Engineering Assessment & Assurance – Analytics, Dynamics and Durability on design analysis
- Fulfills the following FY13 Warfighter Outcomes: MMvr-G-15, Rapidly Cross Wet and Dry Gaps; MMvr-G-8, Mobility Missions; MMvr-G-9, Freedom of Maneuver
- Single, common bridging solution consisting of compact, generic, agile gap crossing equipment adaptable to multiple bridging missions.
- Eliminates need for discrete bridging systems for different missions and levels of traffic
  - Reduces logistical and training footprint/ burden/ cost of Army bridging
  - Reduces amount of equipment, overall payload that needs to be carried
- Enhances Army mobility through adaptability to all encountered site conditions
- Maintains similar load carrying capacity and span capability to that of current bridging systems
- Fulfills one of the needs on MSCoE's 1-N list (MSCoE Endorsement letter pending for this project)

## Schedule

MILESTONES	FY14	FY15	FY16	FY17
Advanced Material Evaluation				
Design Development				
Design Analysis				
Critical Design Review				
Manufacturing Drawing Development				

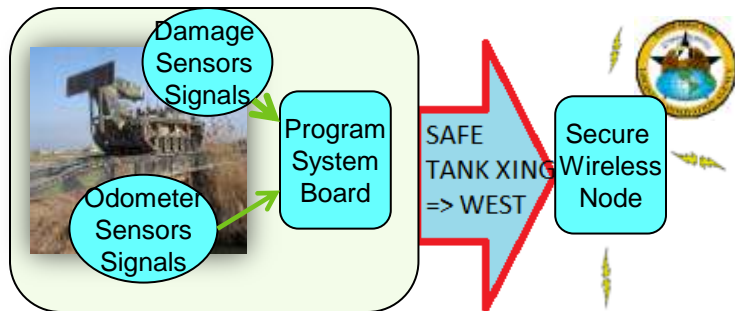
Milestone Indicators: TRL or SRL: Significant Activities:





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# Bridging – Smart Bridge Remote Monitoring



## Purpose:

- Bridging and CSI Team join to experiment with sensors, locations, and algorithms to use SME knowledge to automatically translate sensor readings into actionable information for the user.
- Develop a discrete, low power, adaptable wireless electronics system to monitor use and condition of a variety of assets

## Product(s):

- Software & sensors for JAB (FY14), TDP for modular system board (FY14), ATPD (FY14), software development protocols for future applications (FY15), component bridge demo (FY15).
- System architecture designed for variable # of channels and sensors using **Programmable** system on chip (PSoC).

## Payoff:

- Transitions to PEO-CS&CSS end of FY15 for Joint Assault Bridge.
- Provide the technology to meet remaining service life indicator requirements across fleet and extend usable life of equipment.
- Establish TARDEC as international leader in military bridge health monitoring (Compliments role as Trilateral Design and Test Code National Chair)
- Provides Commander, Maintainer, and asset manager decision-making info without soldier at risk/site.
- Creates modular, common, adaptable smart capability for other candidate assets (i.e. REBS, DSB, LOCB)
- WFO Benefits:
  - (S-2) *Anticipatory Sustainment and Improved Distribution,*
  - (S-7) *Reliability, Prognostics, and Diagnostics*
  - (MMvr-G-18) *Rapid Construction and Repair of Combat Routes and Trails,*
- *TARDEC Capability Enabler (Low-power intelligent wireless sensors)*
- Alignment/support:
  - Next Gen Wireless Communication – LIA PM-NGWC
  - battery-powered electronics – CSI

MILESTONES	FY14	FY15
JAB Software Development	5	
- Prototype Fabrication		
- Prototype Integration		6
Component Bridge Project & Concept Definition	5	
Component Bridge Software Development		
- Prototype Fabrication		
- Prototype Integration and Test		6



U.S. ARMY  
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TECHNOLOGY DRIVEN

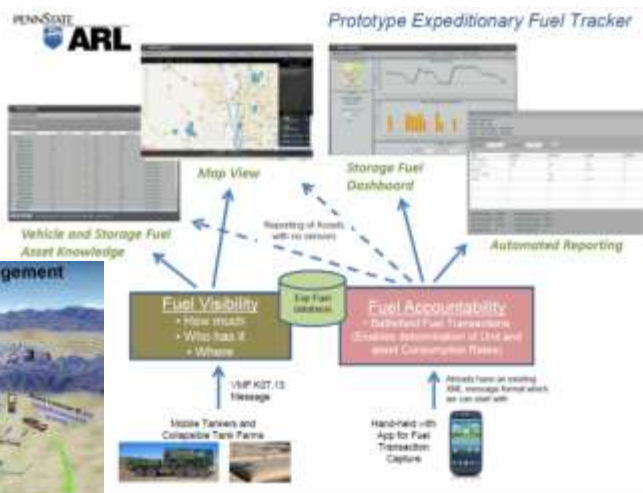
# FPT Life-Cycle Testing and Evaluation



## Laboratories

- Fresh Water Test Facility at Selfridge Air National Guard Base (SANGB)
- Water Test Laboratory (B210)
- Bridging Technology Laboratory at Selfridge Air National Guard Base (SANG)
- Fuels & POL Research Laboratories (B210)
- Army Petroleum Laboratory, New Cumberland, PA
- TARDEC Fuels & Lubricants Research Facility at Southwest Research Institute (GOCO)





## Schedule & Cost

ACTIVITIES/MILESTONES	Prior Year	FY14	FY15	FY16
Develop FBCE Tool				
Develop SoSAT Model				
Develop Sensor/Comms Technology				
Concept Demonstration (E2X LOE)				
ALT ENERGY ADD				
Incorporate FBCE model into SoSAT				
Baseline REPOL Process Flow				
Conduct SoSAT model runs				
Conduct Analysis				
Transition to E2FDS program				

### Purpose:

- Use existing M&S Tools to determine performance requirements for fuel quantity and location sensors to enable intelligent fuel logistics.

### Results/Products:

- Analytical trade study documenting operational, system and logical architecture for optimal echelon reporting frequency in order to reduce resupply time and decrease the fully burdened cost of fuel.
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### Payoff:

- Enable Army to more effectively manage and account for fuel requirements (FY12 purchased over 730M gallons of fuel valued at \$3.6B) in direct support of OEF/OND operations. Currently the Army uses manual measuring and recording TTPs (stick and string method, analog meters, manual forms and ad hoc spreadsheets) to report fuel requirements. Current methods foster a permissive environment where fraud and unexplained loss can occur .